Route to:

Return to:

INSTITUTE OF GAS TECHNOLOGY

THE GAS INDUSTRY'S OWN EDUCATIONAL AND RESEARCH FACILITY

CHICAGO 16, ILLINOIS

GAS ABSTRACTS

VOLUME 7, NUMBER 3

MARCH, 1951

AFFILIATED WITH

ILLINOIS INSTITUTE OF TECHNOLOGY

CONTENTS

1. Gas Industry 33
2. Appliances 33
3. Combustion and Industrial Furnaces 35
4. Carbonization and Gasification 38
5. Natural Gas and Natural Gas Condensates 42
7. Analytical Methods and Tests 44
8. General and Physical Chemistry 45
10. Chemical Engineering 46
11. Process Equipment and Instrumentation 47
12. Materials of Construction 47

GAS ABSTRACTS is published and distributed monthly by the Institute of Gas Technology, Chicago 16, Illinois. The contents of selected papers and patents are reviewed impartially by the editorial staff and material of potential interest to the Gas Industry is presented. Subscription rates to non-members of the Institute: $15.00 per year.—Printed in the U.S.A.

Copyright 1951 by the Institute of Gas Technology.

1. GAS INDUSTRY

Cost Data

COST OF VARIOUS GASES. *Gas Age* **107**, 26-29, 65, 66 (1951) *January* 18.

Cost data to be considered when planning a changeover to natural gas or a mixed gas containing natural gas are presented. One of the several useful tables gives the total conversion cost from 530 Btu per cu ft manufactured gas to gases of higher heating value. These figures per meter are as follows: $8.50 for conversion to 650 Btu per cu ft gas, $18 for change to 850 and $19.85 for change to straight natural gas.

J. D. Parent

Industry Review

Hulcy, D. A. COME PEACE OR WAR GAS INDUSTRY IS READY FOR THE UNCERTAINTIES OF 1951. *Am. Gas J.* **174**, 15-17 (1951) *January.*

At the end of 1950, the gas industry has grown to an $8\frac{3}{4}$ billion dollar industry, with 24,362,000 customers and a 375,000 mile transmission and distribution system. In 1950 total sales amounted to 4,266 million Mcf with revenues of 1,958 million dollars, a gain of 16% over 1949. Expenditures for new facilities and expansion approximated $1,060,000,000 of which $954 million was spent on construction of natural gas pipe line systems. Proved reserves of natural gas at beginning of 1950 totalled 180.3 trillion cu ft and new discoveries continue to exceed the yearly production. Great demand has maintained the importance of the manufactured gas and mixed gas branches of the industry.

O. P. Brysch

LP-Gas Sales

Pugh, K. W. and Benz, G. R. LP-GAS SALES INCREASED 25.4 PER CENT; CUSTOMERS UP TO 7,500,000. *Gas Age* **107**, 31-34, 68, 70 (1951) *January* 18; LP-GAS SALES AND MARKETS FORGE AHEAD. *Natl. Petroleum News* **43**, 14-16, 45 (1951) *January* 10; LP-GAS SALES TEMPO QUICKENS; USE FOR GAS MAKING HOLDS STEADY. *Gas* **27**, 29 (1951) *January;* SALES TOP 3 BILLION IN '50. *LP-Gas* **13**, 36-42 (1951) *January.*

See *Gas Abstracts* 7, 17 (1951) *February* for abstract.

Pipe Lines

FPC HAS APPLICATIONS PENDING FOR 18,000 MILES OF GAS PIPE LINES. *Pipe Line News* **23**, 30-32 (1951) *January.*

A table is presented which shows the mileages of natural-gas transmission pipe line construction which have been authorized by the Federal Power Commission during the period from January 1 to November 10, 1950 for facilities over $700,000 in construction costs. Applications are still pending for 18,000 miles of line. There are now in operation approximately 100,000 miles of main natural gas transmission lines.

O. T. Bloomer

2. APPLIANCES

Burners

Golden, C. E. and Notley, O. L. HIGH PRIMARY TYPE GAS BURNER WITH RADIANT SCREEN. U.S. 2,533,104 (1950) December 5.

A low pressure air entrainment burner is described. Novel design allows 100% primary aeration without flash back tendency. Radiant screen provides means to maintain a high thermal input per unit burner volume.

D. L. Nicol

Minchin, L. T. BURNER BEHAVIOR ON UNUSUAL GASES. PART I. *Coke & Gas* (British) **12**. 409-413 (1950) *November;* PART II. *ibid* 429-432 (1950) *December.*

The various methods of determining the relative interchangeability of different gases are discussed. These methods examine the gas by four methods; (a) cone height curves, (b) flame velocity curves, (c) combustion diagram (aerated burner), and (d) combustion diagram (non-aerated flat flame). These methods must be used when the gases are sufficiently different in characteristics to destroy the use of the Wobbe Index ($H/\sqrt{d}$). Prediction of gas interchangeability by the method of Renauldon and Delaroziere is discussed.

D. L. Nicol

Pickford, J. M. EFFECTS OF CONVERSIONS ON METERS. *Gas* **27**, 25-27 (1951) *February.*

Discussion of the problems experienced after conversion from manufactured gas to a natural gas is given. Typical expected troubles are noted and examples of remedies are described. Meter readings tend to be high because of diaphragm drying and the percentage of "don't register" increases.

D. L. Nicol

INVESTIGATION OF HEATING CONTEMPORARY GAS FOOD SERVICE EQUIPMENT WITH POWER BURNERS. Research Bulletin 61. Am. Gas Assoc. Committee on Industrial and Commercial Gas Research Project IGR-56 (1950) November.

A contemporary Heavy Duty Hot Top Hotel and Restaurant Gas Range designed for atmospheric type burners was tested with various types and positioning of power burners substituted. Advantages with power burners were higher efficiency and lower turndown. Possible disadvantages would be noise. Noise level with the power burner was roughly equivalent to a noisy office.

D. L. Nicol

A STUDY OF FUNDAMENTALS OF DESIGN OF NON-PRIMARY AERATED BLUE FLAME GAS BURNERS. Research Bulletin 62, Am. Gas Assoc. Committee on Domestic Gas Research Project DGR-14-GU (1951) February.

Studies were made on several variations of two basic types of non-primary aerated blue flame gas burners. With proper control of gas pressure their performance compares equally with the usual bunsen type burner. Non-primary aerated burners employing slotted ports were indicated as fundamentally adapted for use with fast burning gases, whereas impingement target designs were more suitable for use with slower burning gases.

D. L. Nicol

Heat Pump

Ambrose, E. R. HEAT-PUMP INSTALLATIONS FOR RESIDENTIAL USE. *Mech. Eng.* **73**, 115-120 (1951) *February.*

A report on the operating and performance characteristics of five heat pump installations in different locations using air as the heat source. Performance was 20 to 30% higher than calculated performance. Some maintenance problems are discussed.

D. L. Nicol

Ruff, A. W. THE HEAT PUMP WATER HEATER. *Refrig. Eng.* **59**, 153, 154 (1951) *February.*

One of the most interesting developments employing the heat pump is an automatic water heater. Obtaining heat from air in the space in which it is located, the heater is claimed to be three to four times as economical as a conventional electrical water heater.

D. L. Nicol

Meters

Bachmann, G. K. THE ECONOMICS OF METERING. PART I. *Gas* **26**, 34-36 (1950) *December;* PART II. *Gas* **27**, 32-35 (1951) *January.*

The points affecting the economics of house gas meters are discussed. These points are: (1) losses in revenue caused by inaccurate meters, (2) fixed charges and investment in meters, interest and taxes, (3) changing of meters for test and repair, (4) replacement cost of condemned meters, and (5) testing and repairing meters. Three methods of making maintenance-meter age studies are detailed.

D. L. Nicol

Pressure Regulator

Bishoff, E. V. SELECTING THE PROPER PRESSURE REGULATOR FOR AN APPLIANCE. *Gas* **27**, 28-30 (1951) *February.*

Methods are given by which proper selection of appliance regulators can be made. This correct regulator can extend the operating range of the appliance with wide fluctuations in line pressure.

D. L. Nicol

Lisk, R. C. ESSENTIAL ELEMENTS OF GAS PRESSURE REGULATORS. *Butane-Propane News* 13, 85, 86, 88, 90-92, 95, 96, 98, 100, 102 (1951) *February.*

An informative elementary discussion of pressure regulator design for those with little experience in regulator design is given. First a simple regulator is built up composed of the three essential elements, a measuring element, a restricting element, and a loading element. The simple regulator is then developed to the commercial design for general use and the commercial design for gas service installations.

D. L. Nicol

Water Heaters

CONDENSATION IN GAS WATER HEATERS. Research Bulletin 58. Am. Gas Assoc. Committee on Domestic Gas Research Project DGR-6-WH (1950) October.

Original data presented and analyzed indicate that for all practical purposes the type of metal usually employed and the emissivity of its surface have no effect on the rate of condensation of water vapor for flue gases. The presence of sulfur in a fuel gas raises the dew point temperature of the flue gases and increases the formation rate of condensate on metal surfaces.

D. L. Nicol

The following article, the abstract for which appears on the page indicated, is also called to your attention:

Wilson, J. T. SAFETY CONTROL GAS BURNER SYSTEM. p. 36.

3. COMBUSTION AND INDUSTRIAL FURNACES

Burning Velocities

Garner, F. H., Long, R. and Ashforth, G. K. EFFECT OF PRESSURE ON BURNING VELOCITIES OF BENZENE-AIR, N-HEPTANE-AIR AND 2, 2, 4-TRIMETHYL-PENTANE-AIR MIXTURES. *Fuel* (British) 30, 17-19 (1951) *January.*

Burning velocities of the above mixtures are measured by the shadow and direct photograph of a bunsen flame. The data exhibit a behavior of the relationship $V_B = cP^n$. The order of magnitude derived for n agrees with literature data.

D. L. Nicol

Combustion

Garside, J.E. THE IMPLICATIONS OF COMBUSTION IN RESEARCH IN GAS UTILIZATION. Gas Research Board Communication GRB-57 (1950) November.

The results of research on gas utilization are summarized. The work is discussed under six sections entitled (1) Flame Propagation, (2) Flame Stability, (3) Mechanisms of Combustion Reactions, (4) Heat and Energy Release, (5) Heat and Energy Transfer, and (6) Ignition of Gas-Air Mixtures.

D. L. Nicol

Fluid Energy Pulverizer

Bechtel, L. D. and Croft, G. M. THE FLUID ENERGY PULVERIZER AND ITS APPLICATION TO STEAM GENERATION. PART I. *Blast Furnace & Steel Plant* 38, 1190-1192, 1216 (1950) *October.*

Pulverization is obtained in the fluid energy mill through the action of superheated steam or air jets on a stream of coarse particles, causing collisions and rapid changes in direction of the material. Pulverized product is removed from the system by entrainment in the jet exhaust, which then passes through a rotating blade classifier. Product fines leave the classifier by entrainment in the classifier exhaust while oversize particles pass to a reject hopper for recycling to the pulverizer. With 750°F superheated steam it is possible to dry the product while pulverizing. Operating data on bituminous coal indicate requirements of 0.4 lb steam/lb coal for a product fineness of 90% through a 200 mesh sieve and only 0.2 lb steam/lb coal if the fineness is lowered to 70% through a 200 mesh sieve. This is equivalent to about 25 kwhr/ton and 16-18 kwhr/ton when using air at 100 psig. An ASME boiler test using West Virginia bituminous screenings indicated a combined net efficiency of boiler and pulverizer of 74.3%, yielding an actual evaporation of 10.68 lb steam/lb coal.

C. Von Fredersdorff

Bechtel, L. D. and Croft, G. M. THE FLUID ENERGY PULVERIZER AND ITS APPLICATION TO STEAM GENERATION. PART II. *Blast Furnace & Steel Plant* **38**, 1332-1335 (1950) *November.*

Two applications of the fluid energy pulverizer to industrial plants are described. In the first case two boilers of a four boiler unit (Babcock and Wilcox Class S-26 500 HP four drum sterlings) were converted from fuel oil firing to a combination coal and oil firing. Results of acceptance tests are summarized as follows:

Pulverization steam, lb/lb coal		0.38
Coal feed, lb/hr		4000
Pulverization fineness,	sieve	% through
	100	97
	200	94
	325	93
Flue gas analysis,	component	%
	CO_2	12.0
	O_2	7.0
	CO	0.0
Generated steam temperature, °F		440
Pulverization steam temperature, °F		820
Equivalent evaporation, lb steam/lb coal		8.5
Furnace heat release, Btu/cu ft/hr		20,000
Combined thermal efficiency, %		73

In the second case a Babcock and Wilcox horizontal tube four drum boiler, originally stoker fired, was equipped with two pulverized coal burners and a fluid energy mill for preparing mixtures of pulverized bituminous coal and coke breeze in any proportion. Indications are that satisfactory ignition can be maintained with coal-coke breeze mixtures.

C. Von Fredersdorff

Gas Burner System

Wilson, J. T. (assigned to Perfex Corp.) SAFETY CONTROL GAS BURNER SYSTEM. U.S. 2,538,222 (1951) January 16.

A safety control feature for control of gas to a main burner and pilot burner of an appliance is described. The operation of the valve controlling the gas flow to the main burner is maintained by a device which depends upon a positive pilot flame for operation. A special pilot burner is provided in which a combustible mixture is burned within a confined space. The volume of gases issuing from the burner increases when combustion takes place within the burner due to expansion of the gases by the temperature of combustion. These combustion gases, containing unburnt gas, then are emitted from the pilot housing to form a second pilot flame for ignition of the main burner gas. With a fixed orifice on the secondary pilot flame, the increase in volume of the combustion products increases the pressure differential as compared to operation with the inner pilot not burning. This pressure differential acts through a pilot regulator to adjust the main burner gas valve.

D. L. Nicol

Gas Glow Tubes

A STUDY OF SMALL DIAMETER GAS GLOW TUBES. Research Bulletin 56. Am. Gas Assoc. Committee on Industrial and Commercial Gas Research Project IGR-55 (1950) October.

A study to obtain heat transfer data on gas glow tubes of diameters 3 inches and less has been made on a small cylindrical furnace. Data were correlated to obtain an empirical relationship for heat transfer coefficients for heat transfer from the burning gases inside the tube to the tube wall. These relationships follow a previous empirical equation for convection coefficients of heat transfer from a gas to the inside of a tube for the small diameter tube of 1 inch ID. This is

$$h_c = \frac{0.0144\ C_p G^{0.8}}{D^{0.2}}$$

In the case of the tube of 3-inch ID a second equation is developed as follows:

$$(h_c + h_r) = 0.0226\ G^{0.73}$$

D. L. Nicol

Gas Turbine

Blake, J. W. COMBINATION GAS TURBINE-STEAM TURBINE UNIT. *Mech. Eng.* **73**, 14-16 (1951) *January.*

A 3500 KW natural gas fired turbine operated successfully for some 7600 hours at 20% above rated capacity and has made the following performance record:

Time on stream, per cent—79.5
Capacity factor, per cent—119.2
Average load on turbine, KW—4118
Recovery from turbine exhaust, KW—2400
Thermal efficiency, per cent—20.2
Fuel cost, gas turbine-steam turbine combination, mills/kwhr—1.170
Fuel cost, total station output, mills/kwhr—1.369

C. Von Fredersdorff

Yellott, J. I. (assigned to Bituminous Coal Research, Inc.) GENERATING ELECTRIC LOCOMOTIVE WITH COAL FIRED GAS TURBINE. U.S. 2,533,866 (1950) December 12.

Twelve claims are granted for a coal fired gas turbine locomotive comprising in particular the following units of equipment: coal bunker with screw feeder, comminuting mill and pulverizer, pulverized coal hopper, pressure combustion chamber, gas turbine with air compressors and electric generators.

C. Von Fredersdorff

Industrial Incinerators

Taricco, L. and Reid, R. H. INDUSTRIAL INCINERATORS. *Gas* 27, 44, 46 (1951) *February.*

Design of industrial incinerators has been developed to provide a secondary combustion zone to burn combustion products of material being burned. This zone eliminates venting of air-polluting substances and odors to the atmosphere and in addition provides a method of preheating the stack on startup, eliminating startup smoke.

D. L. Nicol

Methane-Air Ignition

IGNITION OF METHANE-AIR MIXTURES BY RAPID COMPRESSION. *Nature* (British) 167, 191-192 (1951) *February* 3.

Investigations of the spontaneous ignition of methane-air mixtures by adiabatic compression were made. Previous experiments with methane-air have not exhibited the two-stage ignition characteristics of hydrocarbons of more than three carbon atoms. This study determined that there are two distinct types of ignition at varying compression ratios. This is not proof of a cool-flame region with methane but simply an indication that there are two distinct modes of ignition under adiabatic compression conditions.

D. L. Nicol

Propane-Air Flames

Dugger, G. L. FLAME PROPAGATION. I. THE EFFECT OF INITIAL TEMPERATURE ON FLAME VELOCITIES OF PROPANE-AIR MIXTURES. *J. Am. Chem. Soc.* 72, 5271-5274 (1950) *November.*

A study of the flame velocities of propane-air mixtures is presented. Experimental results tend to prove thermal theory, rather than the diffusion theory, is correct for this reaction.

D. L. Nicol

Simon, D. M. A COMPARISON OF QUENCHING DISTANCE AND INFLAMMABILITY LIMIT DATA FOR PROPANE-AIR FLAMES. *J. Applied Phys.* 22, 103 (1951) *January.*

Literature data for propane-air mixtures are correlated to show that wall quenching limits flame propagation in a tube.

D. L. Nicol

Utilization

Townsend, D. T. A. MODERN IDEAS ON FUEL UTILIZATION. PART 2. *Coke & Gas* (British) 12, 423-425, 432 (1950) *December.*

The application of modern research to combustion problems is discussed. The topics covered include: elimination of smoke by proper combustion conditions, effect of sulfur and ash in corroding and depositing on equipment, superiority of gas over coal in maintaining reducing atmospheres, the advantages of the downjet furnace, and pulverized coal for gas turbines.

W. E. Ball

The following article, the abstract for which appears on the page indicated, is also called to your attention:

Pease, M., Jr. and Brandon, R. J. A PATTERN FOR SOUND FUEL PROCUREMENT. p. 40.

4. CARBONIZATION AND GASIFICATION

Carbureted Water Gas

Cauley, S. P. (assigned to Socony-Vacuum Oil Co., Inc.) MANUFACTURE OF CARBURETED WATER GAS. U.S. 2,539,118 (1951) January 23.

The specific gravity of carbureted water gas produced by conventional processes is reduced by the addition to the enriching oil of a small proportion of an organic nitrogen-containing compound such as quinoline, diphenylamine, benzyl aniline and others.

C. Von Fredersdorff

Cauley, S. P. (assigned to Socony-Vacuum Oil Co., Inc.) MANUFACTURE OF CARBURETED WATER GAS. U.S. 2,539,119 (1951) January 23.

The specific gravity of carbureted water gas produced by conventional means is increased by the addition to the enriching oil of a small proportion of elementary sulfur and aliphatic sulfur compounds such as n-butyl disulfide.

C. Von Fredersdorff

Scantlebury, F. THE ECONOMY AND EFFICIENCY OF C. W. G. PRODUCTION. *Gas Times* (British) 65, 495-498 (1950) *December* 29; *Gas World* (British) 133, 89-92 (1951) *January* 20.

A discussion is presented on the efficiency of carbureted water gas production as affected by the following variables: (1) ratio of air during blow period to steam during run period, (2) proportion of blow and run periods, (3) air blast pressure, (4) fuel bed depth, (5) size of coke, and (6) speed of self-clinkering grate.

C. Von Fredersdorff

Coal Carbonization

Nelson, K. J. (assigned to Standard Oil Development Co.) METHOD FOR FLUIDIZED LOW-TEMPERATURE CARBONIZATION OF COAL. U.S. 2,534,051 (1950) December 12.

The present invention overcomes the usual difficulties in handling wet coal fines by blending the charge with hot, dry, low temperature char, thus drying the mixture by inter-particle heat transfer and obtaining a readily fluidizable treated product.

C. Von Fredersdorff

Nelson, K. J. and Martin, H. A. (assigned to Standard Oil Development Co.) CARBONIZATION OF COAL IN A FLUIDIZED BED. U.S. 2,534,728 (1950) December 19.

Economy of heat transfer and maximum removal of volatile matter is claimed in a fluidized carbonization process utilizing direct heating of the fuel bed by hot flue gases prepared by combustion of a portion of the product char in air or oxygen.

C. Von Fredersdorff

Coal Cleaning

Anderson, R. L. STATISTICAL DATA ON THE MECHANICAL CLEANING OF BITUMINOUS COAL IN THE UNITED STATES. U.S. Bureau of Mines Information Circular 7591 (1951) January.

While only 5% of the production of bituminous coal was mechanically cleaned in 1927, 35% was cleaned in 1949, with 571 plants in operation. This large increase was found necessary because of increased refuse in the raw coal as a result of the gradual transition from hand loading to machine loading. The refuse now being separated amounts to 17% of the raw coal. Of the devices now used for cleaning, jigs (especially the air-pulsated type) continue to be the most popular, followed by concentrating tables, classifiers, launders, and dense medium and pneumatic methods.

W. E. Ball

Coal Drying

Chamberlain, E. A. C. and Waters, P. L. AIR DRYING OF COAL. *Fuel* (British) 30, 3-13 (1951) *January.*

Water is contained in coal in three ways: (1) inherent, or natural moisture as mined, (2) free, or moisture lost on air drying (which includes moisture added after mining) and (3) combined, or water of hydration of the mineral matter. The moisture methods of the DSIR, BS and ASTM are unsatisfactory because of

lack of control of humidity conditions. Effects of humidity conditions upon free and air dried moisture are illustrated and an experimental and a large-scale drying apparatus are described in which close control is possible. Clear cut differentiation of the distribution of the free and the air dried moisture which is necessary for the correct scientific and commercial evaluation of coal can only be achieved by rigid standardization of the air drying conditions.

O. P. Brysch

Coal for Synthetic Fuels

Fraser, T., Crentz, W. L. and Barrett, O. T. PREPARATION CHARACTERISTICS OF SOME COALS AVAILABLE FOR THE SYNTHETIC LIQUID FUELS INDUSTRY. U.S. Bureau of Mines Bulletin 495 (1950).

The ash content of the coal is important in hydrogenation because of the loss of oil encountered in ash elimination. Washability studies on 28 samples of coal from representative fields showed that the coals varied greatly in washability characteristics. Only three of the coals offered any encouragement towards obtaining a product of 2.5% maximum ash content, conforming with English practice. Consequently, an ash tolerance of 4%, conforming with German practice, or above was recommended. The practicability of reducing ash to these low levels depends on the economic disposal of the high-ash secondary coal. Petrographic examination of the 14 x 100 mesh fraction indicated that washing improved the composition by concentrating the opaque matter in the heavy refuse.

W. E. Ball

Coal Preparation

MODERN COAL PREPARATION CUTS INLAND'S PIG IRON COSTS. *Steel* **128**, 74, 76, 79, 80 (1951) *January* 29.

This plant is expected to produce sized coals averaging 3.5% ash from eastern Kentucky coals of 7% ash. Large rock is picked from the run-of-mine coal as the coal is separated into +5 in. and —5 in. sizes. Small rock is removed from the +5 in. coal during the final picking, reclaimable mixtures being crushed and added to the —5 in. coal. The —5 in. coal is blended, and separated into 5 x ⅜ and ⅜ x 0 fractions. The 5 x ⅜ fraction is washed in Link-Belt air-pulsated wash boxes, the +2 in. refuse being crushed and returned. The cleaned coal is dewatered on screens, and sized. The ⅜ x 0 fraction is cleaned on Deister diagonal deck washing tables, and dewatered in Bird centrifugal filters.

W. E. Ball

Coal Properties

Davis, J. D., Reynolds, D. A., Brewer, R. E., Wolfson, D. E., Naugle, B. W. and Birge, G. W. CARBONIZING PROPERTIES: POCAHONTAS NO. 6, DAVY SEWELL, AND FIRE CREEK COALS FROM WEST VIRGINIA AND UPPER AND LOWER KITANNING AND UPPER AND LOWER FREEPORT COALS FROM PA. U.S. Bureau of Mines Bulletin 496 (1950).

This bulletin is No. 52 in a series of reports which up to date have described the carbonizing properties of 379 American coals and their blends. The present report deals with 9 coals; 5 low-volatile West Virginia coals, 2 Pennsylvania and 1 West Virginia medium-volatile and 1 Pennsylvania high-volatile coal. Description, chemical composition, plastic properties, yields of products, chemical and physical properties of products, and coal expansion properties are given in tabulated and graphical form.

O. P. Brysch

Coal Rank

Roberts, J. THE ORIGIN OF RANK IN COALS. *Coke & Gas* (British) **13**, 30-32 (1951) *January*.

The author reviews newer evidence from various sources in support of his theory that differences in the state of maturity of coals are due to differences in temperatures of formation, which result from geo-dynamic forces. This temperature may be directly transmitted from igneous intrusives, or may be generated by compression and motion from either weight of overburden or horizontal thrust. Thus temperature of evolution of volatile matter of a coal

shows it be a natural pyrometer clearly indicating its temperature of formation. Correlation of coal composition with particular geological structures permits the approximate prediction of type of coal in extensions of known coalfields, or in new coalfields.

O. P. Brysch

Coal Selection

Pease, M., Jr. and Brandon, R. J. A PATTERN FOR SOUND FUEL PROCUREMENT. *Mining Eng.* **190**, 177-182 (1951) *February.*

Various properties have been found significant in the selection of coal for boiler fuel in large utilities. The volatile matter is an important consideration, particularly in pulverized coal furnaces, since it indicates ease of ignition and amount of primary air. The swelling index is utilized for blending of coals of same swelling ability for stoker-fired plants. The sulfur content largely determines the lower limit of flue gas temperature. Coals of low ash fusion temperature can cause clinkering on the stokers and ash deposits. Grindability is the characteristic which determines pulverizing mill capacity. High moisture is detrimental from the standpoint of handling difficulties and reduction in thermal value. The quantity and composition of the ash are important because of their effects upon plant efficiency and maintenance. In the years 1940-1946, ash content increased from 7 to 12%, although the trend is now downward. The geographic location of a plant largely determines the choice of fuel. In the Detroit area, the equivalent fuel oil price is normally about twice that of coal, restricting the use of oil to periods of peak demand or coal shortage. Off-season rates for natural gas may make the use of this fuel more attractive.

W. E. Ball

Reiter, F. M. A STUDY OF COAL ANALYSES FROM THE STANDPOINT OF THE USER. *Power Eng.* **55**, 68-73, 124, 126, 128, 130 (1951) *February.*

Coal analyses at four steam and power stations of The Dayton Power and Light Co. showed that ASTM standards should be taken as minimum requirements in sampling coal. Laboratory determinations are generally dependable, the most serious errors being introduced before the sample is brought to the laboratory. The Btu content, the most important property, has declined from 13,700 in pre-war years to 12,700 in 1949, because of increased ash from mechanical mining and greater seam removal. Coal preparation is gradually rectifying this high-ash condition. Low sulfur is favored, because of decreased corrosion of heat exchangers. A boiler can only successfully utilize coals of ash fusion characteristics for which it was designed. Moistures over 6% cause difficulties in unloading, crushing, and handling. Grindability is a significant factor in pulverizer plants. Swelling index may be a valuable guide for some methods of firing, but is not considered important in these plants.

W. E. Ball

Coke Oven

Van Ackeren, J. (assigned to Koppers Company, Inc.) COKE OVEN APPARATUS AND METHOD. U.S. 2,537,197 (1951) January 9. The invention comprises improved means for displacing the basement air of an underjet-fired coke-oven battery, thereby cooling the basement space and preheating the air, part of which is then used in the heating system of the battery. Cooler air blown from enclosed coke side alleys passes across the basement to the regenerator-air inlet-boxes along the enclosed pusher side alley, with air in excess of that needed for combustion voiding itself upward through ducts between the buckstays.

O. P. Brysch

Coking of Coal

Royster, P. H. COAL COKING BY CYCLICALLY CIRCULATED HOT INERT GASES. U.S. 2,536,098 (1951) January 2.

A fixed bed of coal particles of uniform size, held on grate bar supports in a thermally insulated vessel, is coked by forcing downwardly through it a superheated, non-oxidizing gas. The exit gases are cleaned, then recirculated after reheating to 1800°F by forcing them by a blower through incandescent beds of refractory particles. Two reheating beds are provided in regenerative stoves, one in process of heating by auxiliary oil or gas fuels, the other

giving up heat to the carrier gas, these processes being alternately reversed by a reversing valve. The coked bed, in char, or in coherent lumps, is removed by lowering the base and grate bars of the carbonizing chamber. The coke bed may be made more firmly coherent by decomposing within it oil or tar vapors carried in by a cooling carrier gas, or coke may be desulfurized by raising the H_2 content of the hot carrier gas.

O. P. Brysch

Coking Retort

Horner, H. R. and Hennessy, R. J. (assigned to Reilly Tar and Chemical Corp.) COKING RETORT. U.S. 2,537,670 (1951) January 9.

An improved box-like retort for coking pitch and other carbonaceous materials is claimed. The open bottom side of the retort is closed by a slidable door. Refractory metal, removable flues, which seal into the top and bottom of the retort, are heated by gas burners to distill and coke the charge. After vertical withdrawal of the metal flues, the charge may be further calcined by direct-contacting combustion gases. The coked charge drops downward when the bottom is shifted sideways.

O. P. Brysch

Dephenolization Process

Lowenstein-Lom, W. NEW DEPHENOLIZATION PROCESS FOR LOW-TEMPERATURE CARBONIZATION PLANTS. *Petroleum* (British) **14**, 33-35 (1951) *February*.

The aqueous liquor is first steam-heated to break up tar emulsions, and then scrubbed with straw oil in an extraction tower packed with Raschig rings. The oil is dephenolized in a caustic soda scrubber, washed with water and recirculated. The stripped liquor is freed from traces of oil by sand filters, and sprayed on boiler ash, thus reducing the phenol concentration to 10-15 mg/l. It was found that straw oil was superior to benzol for some applications. Organic bases, such as pyridine, improve the efficiency of the scrubbing agent.

W. E. Ball

Fly Ash Handling

Allen, F. B. (assigned to The Allen-Sherman-Hoff Co.) METHOD AND APPARATUS FOR HANDLING FINE SOLIDS. U.S. 2,534,807 (1950) December 19.

Fine solids such as fly ash containing moisture are handled in storage bins by the aid of dry fluidizing gas.

C. Von Fredersdorff

Gas Manufacture Processes

AMERICAN GAS FUNDAMENTALS: PROCESSES FOR MANUFACTURING GAS. *Am. Gas J.* **174**, 27-30 (1951) *February*.

Fundamentals of the production of water gas, carbureted water gas, coke oven gas, producer gas and high Btu oil gas are discussed with the aid of typical flow diagrams.

C. Von Fredersdorff

Low Btu Oil Gas

Taylor, C. L. THE JONES GAS-MAKING PROCESS. *Gas J.* (British) **265**, 165-168 (1951) *January* 17; *Gas Times* (British) **66**, 99-102 (1951) *January* 26; *ibid* 200, 202, 207, 209 (1951) *February* 9; *Gas World* (British) **133**, 130-133 (1951) *February* 3.

Modern British plants for the production of low Btu oil gas (Pacific Coast oil gas) using the Jones process are described. Operating results for such charging stocks as residual fuel oils from Middle East crudes and crude coal tar are given. Present operating methods tend to favor the production of dry carbon black as the major product and of a 360 Btu/Scf oil gas as by-product useful as diluent for carbureted water gas.

H. R. Linden

Metallurgical Coke

Wright, E. W. THE PRODUCTION OF METALLURGICAL COKE IN A MODERN COKE OVEN. *Gas World* (British) **133**, 10-16 (supplement) (1951) *February* 3.

This general discussion of coking practice was awarded the Hebden Prize by the Coke Oven Managers' Association. Among the topics cov-

ered are blending, physical properties of coke, carbonization, battery heating and maintenance, and coke handling.

W. E. Ball

Synthesis Gas Production

Sebastian, J. J. S., Edeburn, P. W., Bonar, F., Bonifield, L. W. and Schmidt, L. D. LABORATORY-SCALE WORK ON SYNTHESIS-GAS PRODUCTION. U.S. Bureau of Mines Report of Investigations 4742 (1951) January.

Operating results of a downflow entrainment type powdered coal gasification unit consisting of a 6 in. diameter silicon carbide tube reactor with pneumatic coal feeding and dry-residue recovery system indicate successful handling of a Wyoming and Sewickley bituminous coal at rates up to 50 lb/hr. Starting with the reactor preheated approximately to operating temperature, oxygen and pulverized coal with a small quantity of steam were added to the top of the reactor while gaseous products and residues exited from the bottom. A number of short duration tests (1-4 hr) were made at essentially non-slagging conditions, some typical results of which are as follows:

Type of coal	Wyoming No. 9
Size of coal, % through 200 mesh	71
Oxygen, lb/lb dry ash-free coal	0.62
Steam, lb/lb dry ash-free coal	0.023
Carrier air, cu ft/lb coal	0.075
Gas heating value, gross Btu/cu ft	313
Gas specific gravity	0.69
Oxygen, cu ft/Mcf make gas	320
Cold gas efficiency, %	46.7

C. Von Fredersdorff

Tar Dehydration

McGraw, W. S. ELECTRICAL DEHYDRATION OF TAR EMULSIONS. *Gas Age* **106**, 28-30, 58 (1950) *December* 21.

The results obtained with an electrical tar emulsion breaking unit installed at the New London carbureted water gas plant of the Connecticut Power Company are discussed.

H. R. Linden

The following articles, the abstracts for which appear on the pages indicated, are also called to your attention:

Joachim, J. L. ORGANIZING A DISTRIBUTION OPERATIONS DEPARTMENT. p. 43.
Powers, E. C. OBTAINING LOWER BTU GASES BY BLENDING NATURAL GAS WITH OTHER GASES OR AIR. p. 42.

5. NATURAL GAS AND NATURAL GAS CONDENSATES

Blending Gases

Powers, E. C. OBTAINING LOWER BTU GASES BY BLENDING NATURAL GAS WITH OTHER GASES OR AIR. p. 42.

174, 19 (1951) *January.*
The flow diagram of a system to blend gases is described. Mixture ratios are recorded and controlled by a continuous recording calorimeter. Power required to compress air for mixing is supplied by making use of the expansion of the high pressure gas through a positive displacement pump.

D. L. Nicol

Corrosion

Hammond, R. E. and Ewing, S. P. PROTECTION OF WELL CASINGS AGAINST EXTERNAL CORROSION. *World Oil* **132**, 154-156, 158 (1951) *February* 1.

Casing leaks in the Loudon pool are caused principally by a galvanic couple between the casing and the surface collecting lines. Approximately a 90% reduction in these leaks has resulted from the electrical insulation of the casing and surface lines. The remaining estimated leaks could be prevented by the application of cathodic protection but it is felt that the cathodic protection would be more expensive than the cost of future leakage repairs. As expected, the casing insulation has increased the rate of corrosion of the surface lines.

B. E. Hunt

Distribution

Joachim, J. L . ORGANIZING A DISTRIBUTION OPERATIONS DEPARTMENT. *Gas Age* **106**, 16, 17, 62, 64, 66 (1950) *December* 21. The advent of natural gas has necessitated the consideration by many companies of a distribution operations department to handle the many problems which develop. The duties of this department basically are to plan a distribution system for the immediate and future load conditions. The underground and construction departments should execute these plans. Various other duties—pressure surveys, district regulators, hourly loads, saturation, and leak detection, are discussed.

B. E. Hunt

Hydrafrac Process

Hassebroek, W. E. APPLICATIONS AND RESULTS OF THE HYDRAFRAC PROCESS. *World Oil* **132**, 133-136, 138, 148 (1951) *February* 1.

Some results obtained with the hydrafrac process of increasing rate of delivery from producing sands are given. It is felt that the process is very promising, although not universally applicable.

J. D. Parent

Pipe Lines

Moore, O. H. PIPE LINE COMPRESSOR LUBRICATION AND MAINTENANCE. *Gas Age* **106**, 23-27 (1950) *December* 21.

Experience of the Tennessee Gas Transmission Co. in the maintenance of lubricating oils used in their gas engine compressors is discussed in considerable detail. Each main engine room is equipped with a set of filters which are manifolded to all engine crankcases so that the oil from each engine is filtered and returned to the engine from which it was taken. For some engines it has been necessary to install individual oil filters. Average horsepower hours per gallon of oil consumed is running about 2700 for the entire system. Several changes to improve the oil purifying system are suggested. The importance of keeping accurate operating records on each engine is stressed.

O. T. Bloomer

Production

Jones, P. J. ELECTRIC LOG RESISTIVITY, POROSITY AND WATER SATURATION FOR CLEAN AND SHALY SANDSTONES. *World Oil* **132**, 140-142, 146, 148 (1951) *February* 1.

The author concludes that shaly sandstone reservoirs usually contain more in place oil and/or gas than is indicated by the electric log data uncorrected for shale content.

J. D. Parent

Logan, L. J. FEWER FLARES LIGHT TEXAS SKIES. *World Oil* **132**, 39, 40, 42 (1951) *February* 1.

Flaring of gas in Texas is still being reduced. It has been cut from 11% in 1939 to 1.2% in 1949. The figure for the first half of 1950 is said to be only half of that for 1949. This is remarkable progress and is made possible by new processing plants and pipe-line outlets. The recent extension of regulation by the FPC is viewed with apprehension by oil producers and this may influence them to withhold gas from sales to pipe line companies.

J. D. Parent

Storage

Fruechtenicht, H. L. and Simpson, J. B. UNDERGROUND STORAGE OF A PROPANE-AIR AND NATURAL GAS MIXTURE. *World Oil* **132**, 183, 184, 186, 188 (1951) *February* 1.

The equipment, procedure and problems in storing mixtures of natural gas, propane and air are presented in considerable detail.

J. D. Parent

Johnson, C. B., Jr. UNDERWATER STORAGE OF PROPANE IN A SALT WATER SAND. *J. Petroleum Technol. Section* **1**, 3, 14-15 (1951) *January*.

Pertinent economic factors in the decision of the Chicago Corp. to store liquid propane underground in a salt water sand are discussed. The project was initiated because of the wide seasonal fluctuations in the propane market and the high cost of conventional storage tanks. The project is still experimental but tests have proved the feasibility of this method of storage.

O. T. Bloomer

The following articles, the abstracts for which appear on the pages indicated, are also called to your attention:

Parker, M. E. CORROSION AND ITS CONTROL. p. 48.

Simon, D. M. A COMPARISON OF QUENCHING DISTANCE AND INFLAMMABILITY LIMIT DATA FOR PROPANE-AIR FLAMES. p. 37.

Spink, L. K. THE GAS ORIFICE METER. p. 47.

Trouard, S. E. PLANNING A CORROSION CONTROL PROGRAM. p. 47.

COST OF VARIOUS GASES. p. 33.

7. ANALYTICAL METHODS AND TESTS

Gas Calorimeter

Gooderham, W. J. A PORTABLE WATER-FLOW GAS CALORIMETER. *J. Soc. Chem. Ind.* (British) 69, 377-379 (1950) *December.*

A relatively small size calorimeter of glass construction is illustrated and described. Gas flow to the calorimeter is measured with a soap-film meter, and water volumes are measured with a burette. Radiation losses or gains are kept to a minimum by enclosing the calorimeter in a silvered vacuum jacket. Operation of the calorimeter to determine the heating value of coal gas requires a gas rate of approximately 0.001 ft^3/min and a supply of compressed air at a rate of about 0.007 ft^3/min. Water flow is adjusted to yield a temperature difference of at least 10°C and combustion is continued until at least 10 ml of water are collected. After achieving steady state conditions, a single determination can be made in 20 minutes on as little as 0.002 ft^3 of gas. Nine determinations on cylinder hydrogen indicated a reproducibility of ±0.1%.

H. Hakewill

Infrared Spectroscopy

Gore, R. C. INFRARED SPECTROSCOPY. *Anal. Chem.* 23, 7-12 (1951) *January.*

This paper presents a brief but very complete survey of the literature dealing with infrared spectroscopy during the past year. Topics reviewed include new books, instrumentation with special reference to the trend towards double beam instruments, qualitative and quantitative analysis, hydrogen bonding, biological, polymers, reactions and combustion, homopolar absorption, intensities and theoretical structural analysis. The bibliography contains 304 references.

S. Katz

Minkoff, G. J. DOUBLE BEAM PERCENTAGE RECORDING INFRA-RED SPECTROMETER. *Fuel* (British) 29, 228-232 (1950) *October.*

A double beam recording infrared spectrometer is described which is based on a monochromator and utilizes both sodium chloride and potassium bromide optics. Besides its use for conventional analytical purposes it has been designed for studies of gas-phase oxidations and combustion reactions.

D. V. Kniebes

Oxygen Determination

Kilday, M. V. A QUANTITATIVE STUDY OF THE CARBON MONOXIDE FORMED DURING THE ABSORPTION OF OXYGEN BY ALKALINE PYROGALLOL. R.P. 2112 *J. Research Natl. Bur. Standards* 45, 43-59 (1950) *July.*

The amounts of carbon monoxide evolved during analytical absorptions of oxygen by alkaline pyrogallol were studied with respect to the composition and methods of preparing solutions, the temperature of reaction, the rate of flow of the sample through the solution, the capacity of the reagent for the absorption of oxygen, the partial pressure of reacting oxygen, and the manner of bringing the gas into contact with the reagent. Less than 0.02% of carbon monoxide was formed during analyses of gases containing as much as 80% of oxygen when the recommended solutions were used in bubbler-type absorption pipettes, and when the samples were passed into the solutions at a rate greater than 20 milliliters per minute at about 25°C. This was true until the solutions had absorbed approximately twelve times their volume of oxygen, after which the formation of carbon monoxide increased significantly. The NBS colorimetric carbon monoxide indicating

gel was used for the quantitative determinations of carbon monoxide. A method was developed for preparing pyrogallol solutions that yielded reproducible amounts of carbon monoxide so small that no significant error was caused in the usual analysis.

Author's abstract

8. GENERAL AND PHYSICAL CHEMISTRY

Bourdon Tubes

Clark, R. A. and Reissner, E. DEFORMATIONS AND STRESSES IN BOURDON TUBES. *J. Applied Phys.* **21**, 1340-1341 (1950) *December.*

Existing solutions of the distribution of stresses in Bourdon tubes are discussed critically, and an alternative solution is proposed, employing the theory of thin shells. This has been used to define the limits of applicability of earlier approximate methods.

S. Katz

High Vacuum Measurement

Wade, F. THE MEASUREMENT OF HIGH VACUUM BY ELECTRICAL METHODS. PART I. *Electronic Eng.* **23**, 30-34 (1951) *January.*

The history and theory of the Pirani, thermocouple and cold cathode type ionization gauges is discussed. Included are graphs showing gauge characteristics and many references to original work.

D. V. Kniebes

Liquid-Vapor Equilibria

Boyd, C. A. CRITICAL BEHAVIOR AND LIQUID-VAPOR EQUILIBRIUM IN MIXTURES OF FLUIDS. *J. Phys. & Colloid Chem.* **54**, 1347-1357 (1950) *December.*

A general discussion is given of the liquid-vapor equilibrium in a binary system. Particular attention is given to the phenomenon of retrograde condensation. The thermodynamics of liquid-vapor equilibrium is developed and the method of calculating equilibrium using the van der Waal equation is outlined. The possibility of using this method to make semi-quantitative equilibrium calculations is indicated.

O. T. Bloomer

Abstractor's note: The method outlined for calculating liquid-vapor equilibrium is not new with the author. The method is identical to that used by Benedict and co-workers except that a considerably more refined equation than a van der Waal was applied by Benedict. This development has met with notable success on binary hydrocarbon systems.

Thermodynamics

Stavely, L. A. K. and Tupman, W. I. ENTROPIES OF VAPORIZATION, AND INTERNAL ORDER IN LIQUIDS. *J. Chem. Soc.* (British) **1950**, 3597-3606 *(December).*

Entropies of vaporization of 53 liquids up to the boiling point were examined in an attempt to relate entropy to the internal orders of the molecules. Seven classes of molecules were studied, monomolecular or highly symmetrical, linear, triangular, pyramidal, cyclic, aliphatic hydrocarbons, and hydroxylic substances. Entropies of vaporization were in all cases compared with a plot of the entropies of the first group, the excess entropies of other groups being considered in terms of the increased order of the molecules due to restricted internal rotation. Molecular properties affecting order and restriction of rotation include moment of inertia, polarity, chain length in paraffins, and double bonds.

S. Katz

The following articles, the abstracts for which appear on the pages indicated, are also called to your attention:

Dugger, G. L. FLAME PROPAGATION. p. 37.

Garner, F. H., Long, R. and Ashforth, G. K. EFFECT OF PRESSURE ON BURNING VELOCITIES OF BENZENE-AIR AND 2,2,4-TRIMETHYLPENTANE-AIR MIXTURES. p. 37.

Gore, R. C. INFRARED SPECTROSCOPY. p. 44.

10. CHEMICAL ENGINEERING

Fluidization

Newton, R. H. (assigned to Houdry Process Corp.) APPARATUS FOR CONTACTING FLUENT SOLIDS WITH GASES U.S. 2,538,-030 (1951) January 16.

A cylindrical vessel for contacting solids and gases is provided with a circular bottom wall and conical grid having a series of openings for the discharge of fluent solids from the container. The vessel is so constructed that solids move downwardly through the bed at substantially constant rates.

C. Von Fredersdorff

Fluidized Catalyst Apparatus

Matheson, G. L. (assigned to Standard Oil Development Co.) FLUIDIZED CATALYST APPARATUS. U.S. 2,537,685 (1951) January 9.

Formation of gas cavities in a fluidized bed is minimized by installation of tubular ventilators disposed vertically within the volume of the fluidized mass. The length of the tubes may be between two and four times the diameter of the containing vessel. The tubes are placed vertically so as to overlap each other by 20-60% and extend from the bottom of the vessel to the top of the fluidized beds. The tubes are arranged around the inside periphery of the vessel.

W. J. Merwin

Gas Liquefaction

Roberts, I. (assigned to Elliott Co.) GAS PURIFYING METHOD AND APPARATUS. U.S. 2,534,478 (1950) December 19.

Compressed, cooled gas is purified and further cooled in a pair of reversing heat recuperators or interchangers, the process being applicable to the liquefaction of the gas.

C. Von Fredersdorff

Heat Transfer

Campbell, J. R. and Rumford, F. THE INFLUENCE OF SOLID PROPERTIES ON HEAT TRANSFER FROM A FLUIDIZED SOLID MEDIUM. *J. Soc. Chem. Ind.* (British) **69**, 373-377 (1950) *December.*

Heat transfer coefficients in fluidized beds of five different solids of widely varying physical properties(copper, graphite, sand, aluminum and catalysts) were measured in 2.31 in. OD x 12 in. long copper tube test section with internal water cooling. Results indicate that the overall heat transfer coefficient h increases with density of the solid, surface per unit volume of the solid, and to some extent with thermal conductivity of the solid. A reasonable correlation of the data is given by

$$h = (0.043)\ (\rho^2/D^3)^{0.283}$$

where ρ denotes apparent density of the solids, g/ml. and D is the average particle diameter, mm. Average results at room temperature show that the heat transfer coefficient in a fluidized bed is 8-17 times higher than in a void tube, as given below.

SOLID	AIR VELOCITY IN BED, FPS	BED TEMP. °C	HEAT TRANSFER h BTU/ SQ FT/HR/°F
Void tube	.33	59.5	4.5
Sand	.34	36.8	25
Aluminum	.34	34.1	43
Graphite	.34	35.2	31
Copper	.32	37.5	77

C. Von Fredersdorff

Evans, S. I. RADIATION FROM NON-LUMINOUS GASES. *Bull. Brit. Coal Utilization Research Assoc.* **14**, 369-381 (1950) *October.* A critical review of the methods used in determining heat transfer by radiation from nonluminous gases is presented. The two gases considered here are CO_2 and H_2O. Examples are given for the three methods of Schack, Landfermann, and Hottel and Egbert.

D. L. Nicol

Gamson, B. W. HEAT AND MASS TRANSFER FLUID SOLID SYSTEMS. *Chem. Eng. Progress* **47**, 19-28 (1951) *January.*

The j-factor type of correlation for evaluating heat and mass transfer between fluids and particles has been made more general. The new development is based on the concept that a continuity exists between fixed and fluidized beds. Correlations are based on previously published data. Reynolds number is defined in

terms of an area per unit volume factor rather than equivalent particle diameter. Fraction voids is also included in the correlation. For non-spherical particles a slope factor is introduced. Mass transfer data for fixed and fluidized beds are correlated within ±10% for particle diameters .09 to .63 in., void volumes 35-94%, gas and liquid films, Schmidt numbers of 1 to 2,000, and modified Reynolds numbers of 7 to 7,000. For heat transfer between fluidized solids and interchangers, the same modified Reynolds number as that used above was employed. Total heat transfer rate is considered equal to that due to the presence of particles plus that which would occur in the absence of particles.

C. L. Tsaros

11. PROCESS EQUIPMENT AND INSTRUMENTATION

Gas Orifice Meter

Spink, L. K. THE GAS ORIFICE METER-1: PRINCIPLE, INSTALLATION, OPERATION. *Am. Gas J.* **173**, 10-12 (1950) *December.*

This article is the first of a two-part review of gas orifice meter principles and practices. In this article the basic principle of operation is briefly treated. The rules for construction and installation of the orifice meter plate and meter run are reviewed. The recommendations are taken from American Gas Association Gas Measurement Committee Report No. 2. Although nothing new is presented the author has digested a set of empirical rules into a concise and usable form.

O. T. Bloomer

Spink, L. K. THE GAS ORIFICE METER. 2. RECORDING INSTRUMENTS—MERCURY MANOMETER TYPE; Nolte, C. B. DUAL-BELLOWS TYPE. *Am. Gas J.* **174**, 20-22, 48 (1951) *January.*

Continuing the two-part series on the gas orifice meter, two types of mechanisms for recording the differential pressure produced by the orifice are described. These are the mercury manometer with float type, and the dual-bellows type. The principle of operation of both types is discussed. Suggestions are given for the installation and calibration of the instruments.

O. T. Bloomer

Heat Exchanger

Wenger, C. J. THREE WAYS TO CLEAN EXCHANGERS. *Petroleum Processing* **6**, 150-153 (1951) *February.*

Heat exchanger cleaning methods at the Wood River refinery of Shell Oil Company are described. The principal techniques used may be classified as: (1) water and water plus abrasive, (2) dry hard abrasive blasting and (3) chemical cleaning. Other methods are also used to a limited extent.

C. H. Riesz

12. MATERIALS OF CONSTRUCTION

Corrosion

Hoar, T. P. SODIUM NITRITE AS AN INHIBITOR AGAINST THE ATTACK OF SEA-WATER ON STEEL. III. INHIBITOR IN SEA WATER/DISTILLED WATER MIXTURES. *J. Soc. Chem. Ind.* (British) **69**, 356-362 (1950) *December.*

The corrosion of mild steel by sea-water/distilled water mixtures at 25°C or 60°C can be completely inhibited by the presence of a sodium nitrite percentage (w/v) greater than ⅓ the percentage of sea-water (v/v). Similar results were obtained for white metal and copper but no decrease in the corrosion of brass was reported. Sodium nitrite is an anodic inhibitor whose main action is believed to be the oxidation of the ferrous, stannous, and cuprous ions to the less soluble higher oxides plus the increase of the pH of the solution.

B. E. Hunt

Holler, H. D. STUDIES ON GALVANIC COUPLES. *Corrosion* **7**, 52-57 (1951) *February.*

This article is composed of three parts. Part I describes a method whereby the effective voltage and internal resistance of a galvanic couple can be measured during current flow. These measurements are quite important when (a) the reference electrode is not in intimate contact with the electrolyte and (b) when the electrode

is covered with a film of high resistance. Part II discusses the potential-current relations which appear in the study of galvanic corrosion. Under the conditions of the experiment a sharp "break" or discontinuity in the potential-current relation was observed which coincided with the point at which the current circulating within the couple was reduced to zero. Part III develops the mechanism of polarization of a galvanic couple. Several methods are discussed for showing the relation between galvanic-couple potential and polarizing currents.

B. E. Hunt

Kornfeld, J. A. PLANNING CORROSION STUDIES. *Oil Gas J.* **49**, 186, 189, 196 (1951) *February* 22.

The procedure for handling a corrosion study as developed by the Atlantic Refining Co. of Dallas is discussed. While the problem may be conceived in either the chemical engineering group, the mechanical engineering group or with the district field engineer, the major part of the study is carried on by the chemical engineering group. The mechanical engineering group is then given the job of lowering the operating costs of the control program.

B. E. Hunt

Parker, M. E. CORROSION AND ITS CONTROL. PART 1. WHAT THE SOIL DOES TO PIPE. *Oil Gas J.* **49**, 111 (1951) *February* 8.

The basic principles of the electrochemical corrosion of buried pipe are explained by means of the analogy between batteries and buried metals. Various dissimilarities which cause corrosion are discussed.

B. E. Hunt

Parker, M. E. CORROSION AND ITS CONTROL. PART 2. HOW TO LOCATE "HOT SPOTS." *Oil Gas J.* **49**, 116-117 (1951) *February* 15.

"Hot spots" are defined as those areas wherein corrosion is most likely to occur. Properly distributed hot spot protection can be expected to provide 90% protection for only about 15% of the cost of protecting the entire buried structure. Hot spots are detected by measuring the resistivity of the soil in which the structure is buried.

B. E. Hunt

Parker, M. E. CORROSION AND ITS CONTROL. PART 3. BASIC PRINCIPLES OF CATHODIC PROTECTION. *Oil Gas J.* **49**, 194, 196 (1951) *February* 22.

Cathodic protection is defined as the process of maintaining a sufficient continuous negative charge at the boundary of the metal-liquid surface to prevent the formation of metal ions. Several sketches are shown illustrating the various methods of achieving cathodic protection.

B. E. Hunt

Parker, M. E. CORROSION AND ITS CONTROL. PART 4. PIPE-TO-SOIL POTENTIALS AS AN INDICATION OF CORROSION. *Oil Gas J.* **49**, 65-66 (1951) *March* 1.

The pipe-to-soil potential measurement readily lends itself to the surveying of pipe lines for evidences of corrosion. Representative curves are presented illustrating the type of data that would be obtained from such a survey.

B. E. Hunt

Trouard, S. E. PLANNING A CORROSION CONTROL PROGRAM: VI. CATHODIC PROTECTION HAS PAID OFF IN NEW ORLEANS. *Gas* **27**, 59-61 (1951) *February*.

This paper summarizes the corrosion control program as it developed in New Orleans. Reference is made to the previously printed parts of the symposium, "Planning a Corrosion Control Program."

B. E. Hunt

CORROSION RESISTANCE OF COPPER AND COPPER ALLOYS. *Chem. Eng.* **58**, 108-112 (1951) *January*.

This is a three-part article presenting considerable information on the corrosion resistance of copper and copper alloys. Part I discusses the effect of general classes of corrosive agents on the corrosion resistance of copper and copper alloys. Some agents discussed are: acids, alkalis, ammonia, salt solutions, gases, organic compounds, fresh water and steam. Part II presents a corrosion rating chart wherein relative corrosion ratings for commonly used copper alloys are given. Part III contains a table listing the approximate composition of the various copper alloys commonly used.

B. E. Hunt

SERVICE TO READERS

Bibliographies and Literature Searches

The library will prepare bibliographies and make literature searches on a cost basis plus a fixed service charge. A comprehensive statement outlining the problem in detail must be presented with the request.

Photocopies

The library will furnish photostatic or microfilm copies of articles abstracted in GAS ABSTRACTS at cost.

Abstracts on Cards

Copies of any abstract in GAS ABSTRACTS on 5 x 8 cards will be supplied on request.

Periodicals Abstracted for GAS ABSTRACTS

American Gas Association Monthly
American Gas Journal
American Petroleum Institute Quarterly
American Society for Testing Materials Bulletin
Analytical Chemistry
Bituminous Coal Research
Blast Furnace and Steel Plant
British Abstracts
British Coal Utilization Research Association Monthly Bulletin
Butane-Propane News
California Oil World
Canadian Chemistry and Process Industries
Canadian Gas Journal
Canadian Journal of Research
Ceramic Age
Chemical Abstracts
Chemical and Engineering News
Chemical Engineering
Chemical Engineering
Chemical Engineering Progress
Chemcial Industries
Chemical Reviews
Chemistry and Industry
Coal Age
Coke and Gas
Combustion
Compressed Air
Construction Methods and Equipment
Corrosion
Engineers' Digest
Fuel Abstracts
Fuel in Science and Practice
Fueloil and Oil Heat
Gas
Gas Age
Gas and Oil Power
Gas Heat in Industry
Gas Journal
Gas Research Board Publications
Gas Times
Gas World
Heating and Ventilating
Heating, Piping and Air Conditioning
Industrial and Engineering Chemistry
Industrial Gas
Industrial Heating
Institution of Gas Engineers: Bulletins, Communications and Transactions
Instruments
Iron Age
Journal of the American Chemical Society
Journal of Applied Mechanics
Journal of Applied Physics
Journal of Chemical Education
Journal of Chemical Physics
Journal of the Chemical Society (London)
Journal of the Institute Fuel
Journal of the Institute of Petroleum
Journal of Metals
Journal of Organic Chemistry
Journal of Petroleum Technology
Journal of Physical and Colloid Chemistry
Journal of Research National Bureau of Standards
Journal of Scientific Instruments and Physics in Industry
Journal of the Society of Chemical Industry
LP Gas
Materials and Methods
Mechanical Engineering
Mining Engineering
National Gas Bulletin of Australia
National Petroleum News
Nature
Nucleonics
Official Gazette of the U.S. Patent Office
Oil and Gas Journal
Operating Engineer
Petroleum
Petroleum Engineer
Petroleum Processing
Petroleum Refiner
Pipe Line News
Power
Power Engineering
Public Utilities Fortnightly
Refrigerating Engineering
Review of Scientific Instruments
Science
Southern Power and Industry
Steel
Transactions American Society of Mechanical Engineers
Transactions of the Faraday Society
U.S. Bureau of Mines Bulletins, Information Circulars Reports of Investigations and Technical Papers
World Oil